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Special Feature: Remediation

A Biological Decontamination Process for Small, Privately Owned Buildings

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An urban wide-area recovery and restoration effort following a large-scale biological release will require extensive resources and tax the capabilities of government authorities. Further, the number of private decontamination contractors available may not be sufficient to respond to the needs. These resource limitations could create the need for decontamination by the building owner/occupant. This article provides owners/occupants with a simple method to decontaminate a building or area following a wide-area release of *Bacillus anthracis* using liquid sporicidal decontamination materials, such as pH-amended bleach or activated peroxide; simple application devices; and high-efficiency particulate air-filtered vacuums. Owner/occupant decontamination would be recommended only after those charged with overseeing decontamination—the Unified Command/Incident Command—identify buildings and areas appropriate for owner/occupant decontamination based on modeling and environmental sampling and conduct health and safety training for cleanup workers.

The consensus document of the American National Standards Institute's Homeland Security Standards Panel (ANSI-HSSP), *American National Standard for Disaster/Emergency Management and Business Continuity Programs,*[1] which was developed in response to *The 9/11 Commission Report,*[2] stated that the private sector, which controls 85% of the critical infrastructure in the nation, remains largely unprepared for a terrorist attack.[1] Further, an urban wide-area recovery/restoration effort will require extensive resources and tax the capabilities of local, state, regional, and federal authorities. In such an event, the number of private decontamination contractors available may not be sufficient to respond to the decontamination needs. In fact, resources may be so limited that decontamination by the owner/occupant may become necessary. Owner/occupant decontamination for a biothreat incident is a concern for several reasons: it has been done on only a very limited basis, and considerable training and health and safety controls are required to enter into and work safely in a contaminated site. Further, owner/occupant decontamination is very dependent on the situation.

This process provides owners/occupants with a simple method to decontaminate a building following a *Bacillus anthracis* (*B. anthracis)* wide-area release. Owner/occupant-performed decontamination is defined here as decontamination using a liquid sporicidal decontamination material, such as pH-amended bleach or activated peroxide, simple application devices, and high-efficiency particulate air

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(HEPA) filter vacuums. The facility owner/occupant may choose to use their own resources or hire a contractor to conduct the decontamination.

After an event, those charged with overseeing decontamination—the Unified Command/Incident Command (UC/IC)—will determine what areas, if any, are appropriate for owner/occupant decontamination based on modeling, sampling, or knowledge of activities that could transport contamination during and after the incident. The UC/IC is a standardized, on-scene, all-hazards incident management system that integrates facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.[3,4] In general, owner/occupant decontamination may be most applicable in areas characterized as residually contaminated (ie, with a very low concentration of the contaminant) or areas that have been contaminated from secondary sources, such as cross-contamination from foot traffic, provided the secondary contamination has resulted in low concentrations of the biohazard. The process is based on guidance provided in the Biological Agent Incident-Response Decision Process.[5]

This article suggests a method to help individuals—specifically building owners and occupants—decontaminate privately owned small commercial, industrial, or residential buildings. Substantial training and health and safety requirements are needed to safely enter into and work in an area contaminated with a biothreat such as *B. anthracis*; they can be found in OSHA's eTool.[6] This information can inform the owner/occupant on liquid decontamination solution application and can help the building owner/occupant decide whether to train personnel and procure equipment and resources in advance of a bioevent.

The technologies described here are those that might be suitable for owner/occupant decontamination: HEPA vacuuming and liquid decontamination technologies. We describe only 2 decon materials: pH-amended bleach and activated peroxides (hydrogen peroxide and peracetic acid solutions). These materials were chosen because they are efficacious against spores and because the public is generally familiar with bleach and peroxide. Other commercially available liquid sporicides exist, and some are registered with the U.S. Environmental Protection Agency (EPA).[7-9] Several other well understood decontamination technologies, such as fumigation with chlorine dioxide or vapor-phase hydrogen peroxide, are also available.[7,10] However, these technologies can only be deployed by contractors or be permanently installed in laboratories or facilities requiring sterile environments; they are not suitable for owner/occupant-performed decontamination. Sensitive or valuable items will require offsite decontamination and are not addressed here.

Because current knowledge on owner/occupant decontamination techniques is limited, incident-specific and site-specific cleanup guidance provided by the Unified Command/Incident Command will be crucial. The IC, with input from other UC participants (including the local health department), will inform building owners on the contamination level of their facility and provide current guidance for decontamination strategy. This guidance should include details on decontamination technology selection and use, where to place waste materials, and a method to evaluate decontamination efficacy or spore-kill. The UC/IC can also offer the guidance and oversight necessary for a complex wide-area cleanup.

More detailed information on facility decontamination methods and concepts is available in *Planning Guidance for Recovery Following Biological Incidents*, by the Biological Decontamination Standards Working Group, Committee on Homeland and National Security, National Science and Technology Council.[5] Facility owners may also be informed by the EPA's Potentially Responsible Parties (PRP) guidance.[11,12] During a wide-area incident, the EPA might deploy an on-scene coordinator (OSC) to provide guidance and monitor the progress of decontamination of several buildings within an area designated for owner/occupant decontamination.

Decontamination science is rapidly evolving.[13-15] Everyone involved in an owner/occupant-performed decontamination should obtain timely information from official sources during all phases of the incident. Users of owner/occupant-performed decontamination methods should follow all directions provided by the manufacturers and the UC/IC. Further, complex legal issues concerning commercial building insurance and mortgage contracts should be carefully considered.

This article is organized according to the basic phases of remediation/cleanup as described in the 2009 National Science and Technology Council's document, *Planning Guidance for Recovery Following Biological Incidents*.[5]

Planning

Planning can include developing a comprehensive facility description, as well as considering factors that could aid in owner/occupant decontamination, should a bioevent occur. Note that these steps can be taken after the bioevent occurs. However, conducting as many steps as possible in the planning stage is likely to produce more comprehensive, accurate, time-saving, and cost-effective results. Figure 1 contains a list of key pre-event planning questions for owners/occupants of relatively complex facilities that may house multiple occupants or businesses and may be large enough to include a facility manager.

Several organizations have developed guidance to assist building owners and operators in addressing issues related to building security and chemical, biological, and radiological (CBR) terrorist attacks.[16-18] Many other organizations have guidance that addresses security needs and disaster response plans for events such as fire, natural disasters, and bomb threats.[11] While this latter guidance may not specifically address a terrorist threat, readers may find portions of the information provided at this website [http://www.epa.gov/

Figure 1. Key Planning Considerations

The list below highlights key issues that might help an owner/occupant plan for owner/occupant decontamination in a relatively complex facility that may include multiple occupants or businesses and be large enough to include a facility manager.

- ☐ Do you have up-to-date floor plans and maps that contain information of floor level, room usage, and HVAC zone coverage?
- ☐ What is the total volume of the building? What is the volume of the facility areas that could be divided into zones? Stairwells, elevators, and escalators that can be hardening or locked-out should be identified.
- ☐ What are the predominant interior construction materials?
- ☐ Is the ventilation system documented? Is there information on where intakes and vents are located and where filters are placed? Note whether a plenum return is present and whether the building air is 100% recycled within, or contains single-pass air, or a combination. Are the HVAC controls labeled and understood?
- ☐ Where are the locations of the water, gas, and electric cut-off valves? Document where the available power, water, and sewers are located.
- ☐ Can the building systems be remotely controlled? Can HVAC, power to critical equipment, and other systems be turned on and off remotely?
- ☐ Do you have utility contact information for advice and service?
- ☐ Are critical areas identified? Critical areas are areas that contain equipment and materials essential for safe and efficient operation. These may require a different decontamination method or material.
- ☐ Is there access to the facility? Document the traffic patterns of vehicles and pedestrians around building.
- ☐ Where can decon equipment and waste be placed? Plan where decon equipment could be staged and where waste generated from the decontamination procedure could be stored.
- ☐ Is there a special security requirement for this building or area? Public buildings may need special security. Air intake may need security.
- ☐ What is the impact to the surrounding buildings and traffic patterns if your facility requires decontamination?

iaq/homeland_security.html] beneficial in establishing their own building's emergency response plans.

Facility Physical Description

Depending on the size or complexity of a facility, the owner/occupant may choose to develop a comprehensive facility description. This requires examination and documentation of many facility dimensions and construction characteristics:

- Maintain a current copy of floor plans and maps that contain information of floor level, room usage, and HVAC zone coverage.
- Document types of interior construction materials.
- Understand and document the ventilation system, including locations of intakes, vents, and filters. Note whether a plenum return is present and whether the building air is 100% recycled within the building or contains single-pass air, or a combination. Label and understand HVAC controls.
- Document the locations of the water, gas, and electric cut-off valves and sewers. Document the utility contact information for advice and service. Determine if the utilities can be remotely controlled from outside the building.
- Document the traffic patterns of vehicles and pedestrians around the building.

Factors to Consider

- Plan where decontamination equipment could be set up and where waste generated from the decontamination procedure could be stored.
- Consider the effect of surrounding building and traffic patterns on the decontamination procedure. Also consider the impact of the decontamination—such as run-off from liquid decontaminants—to neighboring properties.
- For public buildings, identify any special security needs. For example, the air intake may require security. Further, stairwells, elevators, and escalators may need sealing and/or lockout.
- Train individuals for emergency situations, outfit them with proper personal protective equipment, and refresh training annually.
- Consider methods for accessing critical equipment to maintain business continuity and operational capability (eg, exterior power and HVAC controls).

Get Knowledge of the Situation from Official Sources

After a biological event, situational guidance will be available from the IC with agreement from the UC. Specific sources of technical guidance may include a UC Technical

Working Group (TWG), UC Environmental Clearance Committee (ECC), and existing guidance and/or protocols. More details on the UC structure are available in Section 3.3 of the *Planning Guidance for Recovery Following Biological Incidents*.[5]

> The EPA plays a significant role in decontamination efforts: As the crisis management phase transitions into the consequence management phase, EPA steps in as a lead agency. The lead agency during crisis management (FBI, CDC, DHS, or local, county or state entities) may begin to shift the response to EPA, state environmental agencies, cleanup contractors, and consultants working for the facility owners. The main focus will be on characterization and cleanup work.[19(p000)]

EPA's role in a biological response event is described in the National Response Framework's *Emergency Support Function (ESF) #10, Oil and Hazardous Materials Response Annex and Biological Incident Annex*.[20] The NRF details how the nation conducts all-hazards response, from the smallest incident to the largest catastrophe, identifying the key response principles and the roles and structures that organize national response.

ESF #10 provides for a coordinated federal response to actual or potential oil and hazardous materials incidents. EPA's actions can include detecting and assessing the extent of contamination (including environmental monitoring); stabilizing the situation and preventing the spread of contamination; analyzing options for the environmental cleanup and waste disposition; implementing the environmental cleanup; and storing, treating, and disposing of the hazardous materials.[3] Additional information on emergency response can be found at http://www.fema.gov/pdf/emergency/nrf/nrf-esf-intro.pdf. The UC/IC will determine the locations suitable for owner/occupant-performed decontamination.

Take Initial Actions to Protect the Facility

Taking initial action before beginning decontamination can help prevent further contamination and cross-contamination and prepare the facility for safer decontamination. Actions to take may vary depending on whether the facility or portions of the facility have been contaminated, as described below. Additional details are available in the Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH) document, *Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks*.[18]

Measures for Contaminated Facilities and Areas

- Manage or halt incoming and outgoing traffic to minimize exposure and spread of contamination.
- Evacuate all nonessential personnel. If they are contaminated or potentially exposed, follow IC/UC guidance.
- Don the recommended PPE before entering contaminated facilities/areas.[21,22]
- Turn off systems that are commonly controlled separately from the HVAC system, such as all air-handling systems, fresh air intake dampers, and exhaust fans in bathrooms, utility rooms, and kitchens.
- Remove all HVAC filters from the ventilation system. Treat and handle the used filters as contaminated waste.
- If possible, replace HVAC filters with higher filtration efficiency rated filters during the remediation and turn HVAC system on. However, ensure that any pressure drop due to the new filters will not affect the operation of the HVAC system. An operating HVAC system will serve several purposes during remediation:
  - Collect airborne spores onto higher efficiency filters;
  - Create a negative pressure in the building if the exhaust is vented to the outside;
  - Provide a comfortable working environment and temperature for decontamination workers; and
  - Prevent mold growth if the environment is hot or humid.
- Consider placing negative air units (NAUs) in contaminated areas. The NAU system will subject areas to a slightly negative pressure, increasing the likelihood that contaminants and decontamination reagents remain within that area. An NAU consists of a HEPA filter, fan, and stack. Depending on the volume, place enough NAUs in the area to maintain a slight negative pressure (0.05 inches of water). Note that the use of NAUs may also increase the likelihood that exterior contaminants (if any) may be pulled into the building.
- Determine the power requirements for lights and NAUs. Use local power supplies if functional or obtain separate power generation equipment.
- Set up areas for the following:
  - Decontamination reagent supplies and generation equipment;
  - Scrubbing equipment, negative air units, and supplies; and
  - Personnel decontamination tents near selected entrance/exit locations.
- Dispose of all nonessential equipment and materials in accordance with IC/UC guidance. At minimum, the following procedure should be used:
  - HEPA vacuum the material;
  - Decontaminate with a sporicidal solution;
  - Double-bag and seal;
  - Decontaminate the bag externally with a sporicidal solution; and
  - Transport bag off-site for disposal.

Measures to Protect Materials and Equipment

Place uncontaminated critical areas under positive pressure to inhibit contamination from entering these areas via aerosol.

- Implement administrative controls, such as limiting access to authorized personnel.
- Install physical barriers if needed.

Protecting Personnel at Decontamination Sites

The foremost concern in bioevent decontamination is safety. For this reason, only the people involved in the cleanup are in the area. Nonessential people or animals should not enter the area until work is completed. Wherever possible, engineering controls such as increased ventilation and barriers should be implemented to reduce the potential for chemical and biological exposures. Workers that do enter the building must have adequate training and protective equipment, as discussed below. The IC/UC will provide information about administering prophylaxis antibiotics, if needed.

For emergency response and cleanup operations, the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response (HAZWOPER) standard requires a written Health and Safety Plan (HASP) and addresses requirements for medical surveillance, training, planning, and several important site-specific activities.[23]

Decontaminate the Facility

The owner/occupant must make several decisions about the decontamination process before work can begin. A major decision is whether the owner/occupant will conduct the decontamination with in-house resources or whether a contractor will be hired. Other decisions revolve around equipment and materials to be used and whether items will be removed for treatment as waste or as valuable items requiring off-site decontamination, such as fumigation conducted by a contractor. In addition, the owner/occupant must identify a process that will effectively decontaminate the facility.

A number of factors will influence the decision. Site-specific conditions and the characteristics of the spore—obtained from official sources—will influence the selection of technologies. Decon material selection must take into account cost issues; product safety, efficacy, building materials compatibility, and practicality; and the health risks associated with the material. There are a number of documents and resources to aid those making these decisions.[24,25] The EPA website is a valuable resource for owners and occupants who choose to hire a professional decontamination contractor to conduct operations (http://www.epa.gov).

Liquid Decontamination Agents

Generally, liquid reagents should be used to decontaminate only hard, nonporous surface areas or items. However, new information suggests that some liquid technologies are efficacious on some porous materials. (For more details, see www.epa.gov/nhsrc/pubs.) The reagents selected for owner/occupant decontamination should have Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) registration or received a crisis or quarantine exemption.

A pH-amended bleach solution has been found to be more efficacious against spores than nonamended bleach, and EPA has registered use of pH-amended bleach to treat *B. anthracis* (in accordance with the requirements of crisis exemption under Section 18 of FIFRA). However, the efficacy of bleach against *B. anthracis* spores depends on specific conditions, including temperature, pH, organic load, concentration and contact time, and the type of surface material.[8] Treated surfaces need to remain in contact with the bleach solution for up to 60 minutes; repeated applications may be necessary to keep the surfaces wet. Bleach is a strong oxidizing agent and may damage some surfaces due to its corrosivity. Rinsing the treated surfaces will limit further damage.

As with pH-amended bleach, hydrogen peroxide/peroxyacetic acid–based solutions are efficacious for decontaminating nonporous surfaces contaminated with spores. Activated hydrogen peroxide solutions, which result in solutions containing peroxyacetic acid, are also efficacious. Commercially available peroxide-based decontamination solutions include: Peridox™ (EPA Reg. No. 81073-2), SporKlenz, RTU™, Easy Decon 200™, MinCare™, Oxonia, Active™, KX-6049, Actril Cold Sterilant, and Virex STF. Note that Peridox™ is the only sporicidal decontaminant registered by the EPA for inactivation of *B. anthracis* spores on hard, nonporous surfaces.

A benefit of a simple activated peroxide solution is that hydrogen peroxide decomposes into water and oxygen, whereas bleach (hypochlorite) decomposes into chlorate and chloride ions, oxygen, and chlorine. Chlorine can accumulate in a closed or sealed room and can be harmful when inhaled. A simple activated peroxide solution with no ingredients other than hydrogen peroxide, buffer, and an activator decomposes into water and oxygen, and it is considered less corrosive than bleach.

Owner/Occupant Liquid Decontamination Process

Figure 2 provides a decontamination process that the owner/occupant can use with one of the liquid decontaminants discussed above: a hydrogen peroxide/peroxyacetic acid solution or a pH-amended hypochlorite solution. Figure 2 assumes that

Figure 2. Technique for Applying Liquid Decontamination

Liquid Decon Application Technique[1,2]
Pre-application Steps
1. If possible, replace all filters in the ventilation units with high-efficiency filters. Alternatively, turn off the ventilation system and place a HEPA-filtered portable air scrubber with ductwork running from the system to somewhere outside of the project area in order to maintain negative pressure in relation to the cold zones (noncontaminated zones).
2. Obtain an efficacious liquid sporicidal—Peridox™ (EPA Reg. No. 81073-2) or pH-amended bleach—that has received EPA registration for use against *B. anthracis*. Use unregistered peroxide-based products, such as SporKlenz RTU™, Easy Decon 200™, MinCare™, and Oxonia™, only after they have been approved under a FIFRA exemption.[3-5]
3. Remove nonessential materials and porous materials, such as fabric drapes, sofas, and chairs. Consider cost efficiency of replacing nonessential items rather than decontamination.
4. Identify valuable materials that may be damaged by decontamination with liquid materials. Double bag and label these for off-site decontamination. Apply liquid sporicidal decontaminant (see 2 and 3 above) to the outer bag for the required contact time prior to their removal.
Pre-cleaning
5. Pre-clean all surfaces with a wet/dry vacuum fitted with a HEPA-rated filter. Dispose of HEPA filters as contaminated waste.
6. On heavily soiled surfaces only, wash off dried-on dirt, oils, or grease by scrubbing with a brush, soap, and water. Rinse the surface with water. Vacuum standing water from horizontal surfaces with the wet/dry vacuum.[6]
Decontamination
7. Keep the surfaces wetted with the decon solution for the required time period (eg, 30 min), reapplying solution as needed to maintain wetness.
8. Rinse if required per manufacturer's directions.
9. Wet-vacuum or mop any residual standing liquid.
Reapplication (if needed)
10. Pending results of posttreatment sampling, reapply the decontamination solution if needed.

Note: Decontamination processes are subject to oversight by the UC and may require site-specific modification.

[1]USEPA/NDT Decontamination Analytical and Technical Service (DATS) Contract Number: EP-W-06-089 TDD No. TO-02-07-12-0016. After Action Report Danbury Anthrax Incident. September 19, 2008. Kelly Smith (Dynamac Corp.) Michael J. Nalipinski, EPA/OSC.

[2]Ryan SP, Calfee W, Lee SD, et al. Assessment of Liquid and Physical Decontamination Methods for Environmental Surfaces Contaminated. May 28, 2009.

[3]See the EPA website for the latest information on products registered as sporicidal decontaminants (http://www.epa.gov).

[4]Several commercially available products (peroxide/PAA or activated-peroxide solutions) are efficacious for spores; see Wood JP. *Technology Evaluation Report: Evaluation of Liquid and Foam Technologies for the Decontamination of B. anthracis and B. subtilis Spores on Building and Outdoor Materials: DioxiGuard™ (Frontier Pharmaceutical), pH-Amended Bleach, Calcium Polysulfide, CASCAD™ Surface Decontamination Foam (Allen-Vanguard), Oxonia Active® (Ecolab Inc.), Minncare® Cold Sterilant (Minntech Corp.) and SanDes (DTI-Sweden AB)*. EPA/600/R-09/150, November 2009. www.epa.gov/ord. http://www.epa.gov/nhsrc/pubs/600r09150.pdf.

[5]Note that regular household (3%) hydrogen peroxide is not efficacious on spores (SAND# 2010-2584C).

[6]Vacuum and washing may cause contaminant spread. These steps should be used only on heavily soiled surfaces (see Ryan *et al.*, 5/28/09).

the facility owner has received guidance from the UC that owner/occupant decontamination is a suitable decontamination technique for the facility and that the workers are following OSHA's regulations for safety and health.

A large facility should be organized into decontamination zones. These zones are based on the physical structure, building usage, and air handling unit considerations. After decontamination, each zone or area should be isolated from the remaining contaminated areas. Small buildings and residences can be treated as a single unit. Nonetheless, after decontamination, rooms should be isolated or closed to prevent recontamination.

Off-Site Decontamination for Sensitive Items

Items to be retained that cannot be decontaminated on-site by using common liquid sporicidal materials or HEPA vacuuming will need to be shipped off-site for decontamination. Sensitive and valuable items such as artwork, documents, money, and electronics are items for which it is not feasible to use liquid decontamination. If HEPA vacuuming does not successfully decontaminate these items, or it is not economically feasible, then gaseous or radiation decontamination technologies will need to be incorporated at specialized off-site facilities. Some of these technologies include the following chemical decontamination materials in a gaseous or vaporous form: chlorine dioxide, hydrogen peroxide, methyl bromide, and ethylene oxide. In addition, ionizing irradiation has been used to decontaminate mail and other paper documents.

Liquid decontaminants should not be used on valuable equipment, such as ATM equipment, cash registers, essential computers, and security cameras. Off-site decontamination using fumigation or irradiation is recommended for this equipment. Fumigation must be performed by a licensed

contractor. The following process can be used to process valuable items:

- Vacuum equipment thoroughly using HEPA vacuums. Double-bag the item, then decontaminate the outside of the bags prior to transporting.
- Remove bagged equipment from the contaminated area and to location for fumigation/irradiation off-site.
- After decontamination, lock and tag it as out-of-service until sampling is complete and the results show no growth.

Fumigation will require that products be placed within a gas-tight chamber, with gas concentration, temperature, relative humidity, and time of exposure carefully controlled. Irradiation sterilization techniques include exposure to high-energy electrons from particle accelerators or high-energy electromagnetic radiation in the form of x-rays or gamma rays. However, irradiation can destroy magnetic media, such as film or videotape, and tends to be expensive. Regulatory authority over irradiation is governed under the Food and Drug Administration's medical instrument regulations.

Conduct Post-Decontamination Activities

A number of required procedures follow decontamination activities including personnel and equipment decon, waste handling, and clearance to reenter the facility. The purpose of personnel and equipment decontamination stations is to prevent human exposures during the removal of contaminated clothing or handling of contaminated tools, equipment, and instruments. Decontamination is an integral part of the requirements established by OSHA for protection of workers and by EPA for protection of public health and the environment.[6] All decontamination station protocols should be in accordance with UC guidance.

After completing all decontamination activities, the owner/occupant must consult with the Unified Command about procedures to ensure that the building is safe to reenter. These procedures many include sampling and culturing to check for the presence of any live spores. At the completion of these activities, the UC decides if the building is safe for reentry.

Waste Handling

Off-site decontamination technologies for waste materials may be most expedient and/or cost-effective. Some owner/occupants may choose to decontaminate waste materials on-site. However, a method to confirm the effectiveness of treatment—such as taking samples to be cultured and analyzed for spore viability[3]—may be required. If laboratory results meet the clearance goals set by the UC, then treatment is considered effective and the treated items are cleared for removal. These decontaminated items are considered nonhazardous waste and can be disposed of as municipal solid waste following appropriate state or local regulatory requirements.

Liquid waste should be placed in a watertight primary receptacle that is then placed in a secondary watertight receptacle. Absorbent material is added between the primary and secondary receptacles to absorb the entire contents, if spilled. The outer packaging is required to have adequate strength for capacity, mass, and intended use. An itemized list of package contents should be placed between the secondary receptacle and outer packaging.

Nonessential materials, such as carpeting and furniture, should be treated with pH-amended bleach or other liquid decontamination materials prior to removal. Items that are cleared by posttreatment verification sample culture analysis may be considered decontaminated and disposed of as nonhazardous waste. Items that are not cleared (such as porous materials) should be bagged, removed from the facility, and decontaminated or incinerated off-site.

B. anthracis–contaminated waste may be stored for further treatment in sealed containers that are appropriately labeled. The waste should be collected and stored separately in 1 of 3 categories:

- Debris such as food stuffs from the contaminated areas;
- Waste generated from personnel entering hot zones (eg, PPE and personnel rinsate); and
- Chemical wastes generated during decontamination.

Waste that is temporarily stored before transport to off-site disposal must be placed in containers that meet the Department of Transportation Division 6.2 (Infectious Substances) packaging requirements. The storage area must provide weather protection and prevent access by unauthorized individuals or by vermin.

Conclusion

In the event of a wide-area biological attack, resources may be so limited that decontamination by the owner/occupant may become necessary. This prospect raises concerns, because considerable training and health and safety controls are required to work safely in a contaminated site. Nevertheless, a process for owner/occupant decontamination may useful in some situations identified by the Unified Command/Incident Command. This article provides owners/occupants with a simple method to decontaminate a building or area following a wide-area release of *B. anthracis* using liquid sporicidal decontamination materials and application devices. Franco and Bouri stated that several gaps

exist in the U.S. ability to respond to a large-scale bioterrorism attack.[26] One gap identified was the lack of guidance for building owners. The decontamination process described in this article is another strategy for decision makers to consider in the event of a wide-area biological attack.

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